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# Lakes Vernon and Anacoco Vernon Parish, Louisiana

National Eutrophication Survey, Corvallis, Oreg

Prepared for

Corvallis Environmental Research Lab, Oreg

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PB 270 078

# U.S. ENVIRONMENTAL PROTECTION AGENCY
# NATIONAL EUTROPHICATION SURVEY

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# Report
# on
# Lakes Vernon and Anacoco
# Vernon Parish
# Louisiana

EPA Region VI

Working Paper No. 528

With the cooperation of the

Louisiana Wild Life and Fisheries Commission

and the

Louisiana National Guard

March, 1977

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16 ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17 KEY WORDS AND DOCUMENT ANALYSIS

| a. DESCRIPTORS | b. IDENTIFIERS/OPEN ENDED TERMS | c. COSATI Field/Group |
|---|---|---|
| eutrophication<br>lakes<br>nutrients<br>phosphorus<br>nitrogen<br>loading | | 05B<br>05C |

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# REPORT ON LAKES VERNON AND ANACOCO

## VERNON PARISH, LOUISIANA

## EPA REGION V

by

National Eutrophication Survey

Water and Land Quality Branch
Monitoring Operations Division
Environmental Monitoring & Support Laboratory
Las Vegas, Nevada

and

Special Studies Branch
Corvallis Environmental Research Laboratory
Corvallis, Oregon

Working Paper No. 528

OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY

March 1977

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# FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

## OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point source discharge reduction and nonpoint source pollution abatement in lake watersheds.

## ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

## LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by the U.S. Environmental Protection Agency and to augment plans implementation by the states.

ACKNOWLEDGMENTS

The staff of the National Eutrophication Survey (Office of Research and Development, U.S. Environmental Protection Agency) expresses sincere appreciation to the Louisiana Wild Life and Fisheries Commission, Division of Water Pollution Control for professional involvement, to the Louisiana National Guard for conducting the tributary sampling phase of the Survey, and to those Louisiana wastewater treatment plant operators who provided effluent samples and flow data.

Robert A. Lafleur, Chief; J. Dale Givens, Assistant Chief; Lewis R. Still, Biologist; Louis Johnson, Biologist; Lee Caubarreaux, Biologist; Darrell Reed, Engineer; Dempsey Alford, Biologist; and Elwood Goodwin, Water Quality Control Technician, all of the Louisiana Wild Life and Fisheries Commission, Division of Water Pollution Control reviewed the preliminary reports and provided critiques most useful in the preparation of this Working Paper Series.

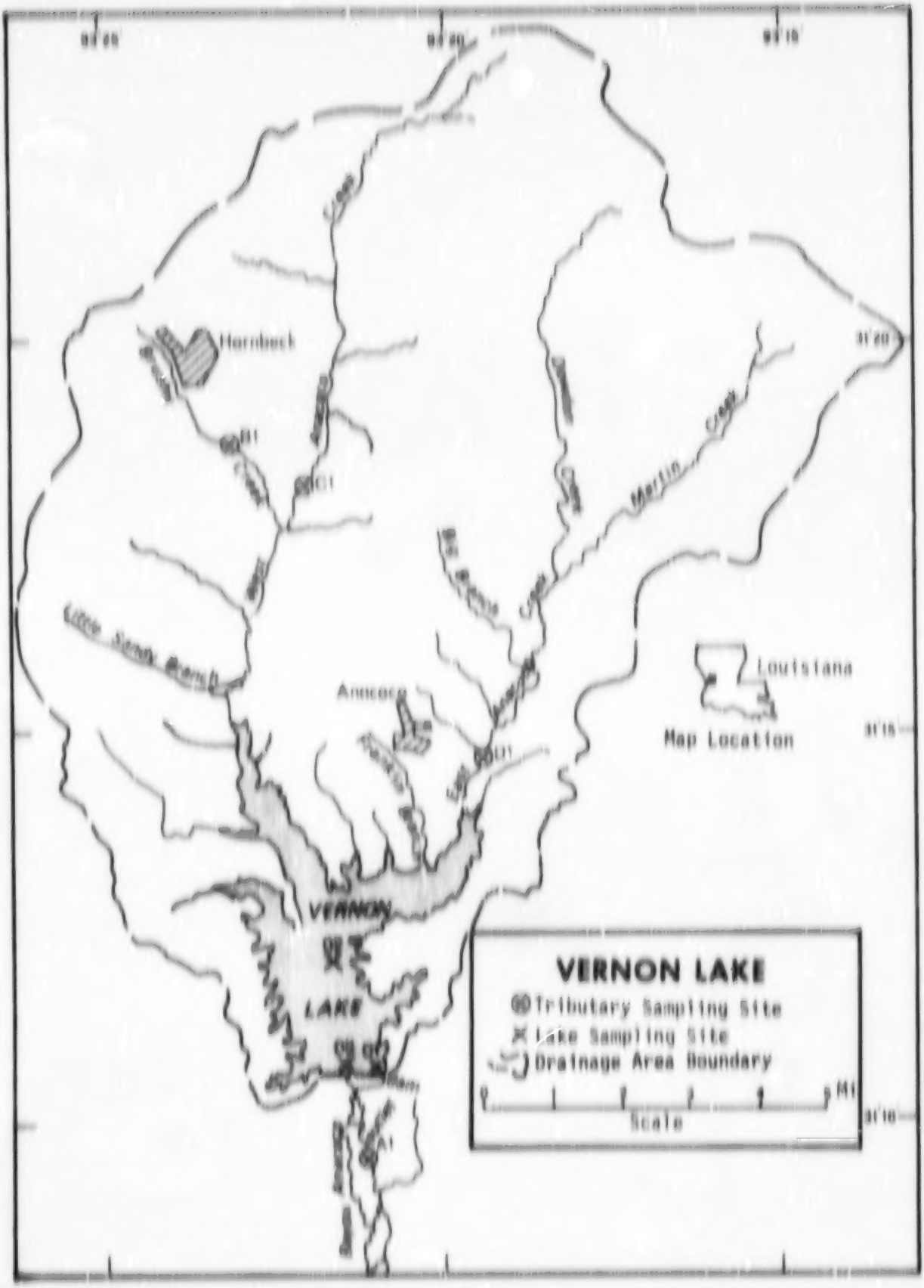
Major General O'Neil Daigle, Jr., the Adjutant General of Louisiana, and Project Officer Colonel Lawrence P. Dupre, who directed the volunteer efforts of the Louisiana National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

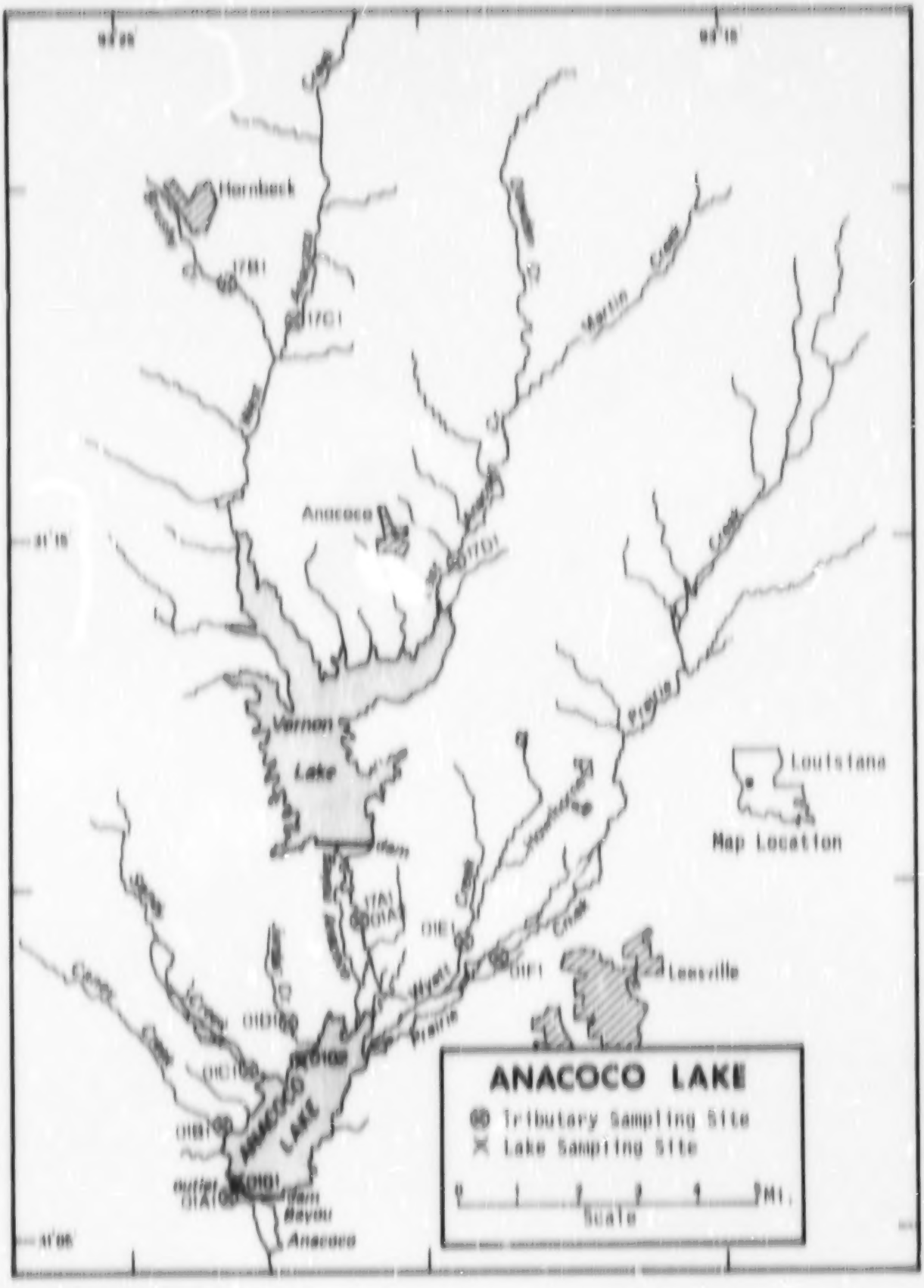
NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF LOUISIANA

| LAKE NAME | PARISH |
|---|---|
| Anacoco Lake | Vernon |
| Lake Bistineau | Bienville, Webster |
| Black Bayou | Caddo |
| Black Lake | Natchitoches and Red River |
| Bruin Lake | Tensas |
| Bundick Lake | Beauregard |
| Caddo Lake | Caddo (Menon and Harrison in Texas) |
| Cocodrie Lake | Concordia |
| Cocodrie Lake (Lower) | Rapides |
| Concordia Lake | Concordia |
| Cottie Lake | Rapides |
| Cross Lake | Caddo |
| D'Arbonne Lake | Union |
| False River Lake | Pointe Coupee |
| Indian Creek Reservoir | Rapides |
| Saline Lake | LaSalle |
| Turkey Creek Lake | Franklin |
| Lake Vernon | Vernon |
| Lake Verret | Assumption |


Hornbeck
Louisiana
Map Location
Annex
VERNON
LAKE
VERNON LAKE
Tributary Sampling Site
Lake Sampling Site
Drainage Area Boundary
Scale


Hornbeck
Anacoco
Vernon Lake
Louisiana
Map Location
Leesville
ANACOCO LAKE
Tributary Sampling Site
Lake Sampling Site
Scale
Mi.
Bayou Anacoco

# REPORT ON LAKES VERNON AND ANACOCO, LOUISIANA
# STOREY NOS. 2217 and 2201

## I. CONCLUSIONS

### A. Trophic Condition:*

On the basis of field observations and survey data, Lakes Vernon and Anacoco are considered mesotrophic. Of the 19 Louisiana lakes sampled in 1974, 18 had higher median total and orthophosphorus values, and 8 had higher inorganic nitrogen than Lake Vernon. Chlorophyll a levels ranged from 3.0 µg/l to 7.8 µg/l with a mean of 4.9 µg/l. Potential for primary production as measured by algal assay control yield was low. Marked depression of dissolved oxygen with depth occurred at Station 03 during May and November sampling. Survey limnologists reported heavy concentrations of floating macrophytes at the north end of the lake.

Of the 19 Louisiana lakes, 16 had higher median total and orthophosphorus levels, and 14 had higher inorganic nitrogen levels than Anacoco Lake. Chlorophyll a ranged from 5.1 µg/l to 13.6 µg/l, with a mean of 8.7 µg/l. Although the lake has a past record of problem macrophytes, Survey limnologists did not observe any nuisance conditions during their visits to Anacoco Lake.

*See Appendix E.

B. Rate Limiting Nutrient:

Algal assay results indicate that Lakes Vernon and Anacoco were growth limited by available phosphorus levels during both spring and autumn sampling. Mean inorganic nitrogen to orthophosphorus (N/P) ratios for Lake Vernon were 26/1, 28/1, and 23/1 for the three sampling seasons, indicating phosphorus limitation. However, mean N/P ratios for Anacoco Lake were 13/1 or less on all three sampling occasions, suggesting nitrogen limitation.

C. Nutrient Controllability:

1. Point sources -

There were no known point sources impacting Lakes Vernon and Anacoco during the sampling year. The mean annual phosphorus loading of 0.24 g $P/m^2/yr$ for Lake Vernon was less than the "oligotrophic" level proposed by Vollenweider (1975) for a lake with such volume and detention time. If this low phosphorus loading can be maintained, the existing excellent water quality of Lake Vernon should persist.

The phosphorus loading of 0.61 g $P/m^2/yr$ for Anacoco Lake is greater than Vollenweider's "oligotrophic" level but less than his "eutrophic" value. However, loading calculations yield a net export of both phosphorus and nitrogen from Anacoco Lake, suggesting sampling was not adequate to depict

actual loading and export rates. This export could be attributed to inaccurate estimation of loading values for the unmeasured tributaries (see Section IV-E) or to undetected discharges reaching the lake from unknown municipal or industrial sources. Additional sampling is needed before a nutrient budget for Anacoco Lake can be determined; nevertheless, any addition to the present phosphorus loading should be carefully evaluated in order to maintain the lake's existing high quality.

2. Nonpoint sources -

The mean annual phosphorus loads from measured tributaries amounted to 60.7% and 85.7%, respectively, of the total loads to Lakes Vernon and Anacoco. The estimated phosphorus loads from ungaged drainage areas were respectively 31.6% and 11.0%.

## II. LAKE AND DRAINAGE BASIN CHARACTERISTICS

Lake and drainage basin characteristics are itemized below. Lake morphometry was provided by the State of Louisiana; tributary flow data were provided by the Louisiana District Office of the U.S. Geological Survey (USGS). Outlet drainage area includes the lake surface area. Mean hydraulic retention time was obtained by dividing the lake volume by mean flow of the outlet. Precipitation values are estimated by methods as outlined in National Eutrophication Survey (NES) Working Paper No. 175. A table of metric/English conversions is included as Appendix A.

A. Lake Morphometry:

| | | Lake Vernon | Anacoco Lake | |
|---|---|---|---|---|
| 1. | Surface area: | 17.09 | 10.52 | $km^2$. |
| 2. | Mean depth: | 4.1 | 2.8 | meters. |
| 3. | Maximum depth: | 15.2 | 10.7 | meters. |
| 4. | Volume: | 70.309 | 29.603 | $\times 10^6 m^3$. |
| 5. | Mean hydraulic retention time: | 197 | 45 | days. |

B. Tributary and Outlet (See Appendix B for flow data):

1. Tributaries -

| Lake Vernon | | | Anacoco Lake | | |
|---|---|---|---|---|---|
| Name | Drainage area ($km^2$) | Mean flow ($m^3/sec$) | Name | Drainage area ($km^2$) | Mean flow ($m^3/sec$) |
| B-1 Brushy Creek | 15.3 | 0.27 | A-2 Bayou Anacoco | 286.3 | 4.34 |
| C-1 West Anacoco Creek | 57.5 | 0.80 | B-1 Caney Creek | 16.1 | 0.25 |
| D-1 East Anacoco Creek | 45.8 | 1.34 | C-1 Sandy Creek | 40.9 | 0.57 |
| | | | F-1 Prairie Creek | 115.0 | 1.61 |
| Minor tributaries and immediate drainage - | 106.8 | 1.76 | Minor tributaries and immediate drainage - | 58.9 | 0.57 |
| Total | 270.4 | 4.13 | Total | 520.2 | 7.34 |
| 2. Outlet - A-1 Bayou Anacoco | 286.3 | 4.34 | A-1 Bayou Anacoco | 538.7 | 7.55 |

C. Precipitation (both lakes):

1. Year of sampling: 162.2 cm.
2. Mean annual: 138.0 cm.

## III. LAKE WATER QUALITY SUMMARY

Lakes Vernon and Anacoco were sampled three times during the open-water season of 1974 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from three stations on Lake Vernon and two stations on Anacoco Lake, and from one or more depths at each station (see maps, pages v-vi). During each visit, depth-integrated samples were collected from each station for chlorophyll a analysis and phytoplankton identification and enumeration. During the first and last visit, 18.0-liter depth-integrated samples were composited for algal assays. Maximum depths sampled were:

| | Lake Vernon | Anacoco Lake | |
|---|---|---|---|
| Station 01 | 9.1 | 4.3 | meters |
| Station 02 | 3.7 | 2.1 | meters |
| Station 03 | 9.1 | | meters |

For a more detailed explanation of NES methods, see NES Working Paper No. 175.

The results obtained are presented in full in Appendix C and are summarized in III-A for waters at the surface and at the maximum depth for each site. Results of the phytoplankton counts and chlorophyll a determinations are included in III-B. Results of the limiting nutrient study are presented in III-C.

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

| | | |

2. Chlorophyll a -

| Lake Vernon | | | Peacock Lake | | |
|---|---|---|---|---|---|
| Sampling Date | Station Number | Chlorophyll a (µg/l) | Sampling Date | Station Number | Chlorophyll a (µg/l) |
| 05/20/74 | 01 | 3.5 | 05/20/74 | 01 | 5.7 |
| | 02 | 3.0 | | 02 | 6.3 |
| 05/30/74 | 01 | --- | 05/30/74 | 01 | 9.8 |
| | 02 | 7.8 | | 02 | 13.6 |
| | 03 | 6.8 | | | |
| 11/05/74 | 01 | --- | 11/05/74 | 01 | 9.3 |
| | 02 | 3.0 | | 02 | 8.7 |
| | 03 | 4.5 | | | |

c. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

| Spike(mg/l) | Lake Vernon | | | Anacasc Lake | | |
|---|---|---|---|---|---|---|
| | Ortho P Conc.(mg/l) | Inorganic N Conc.(mg/l) | Maximum Yield (mg/l-dry wt.) | Ortho P Conc.(mg/l) | Inorganic N Conc.(mg/l) | Maximum Yield (mg/l-dry wt.) |
| a. 03/20/74 | | | | | | |
| Control | 0.010 | 0.189 | 0.1 | 0.010 | 0.050 | 0.7 |
| 0.05 P | 0.060 | 0.189 | 3.6 | 0.060 | 0.050 | 7.9 |
| 0.05 P + 1.0 N | 0.060 | 1.189 | 10.4 | 0.060 | 1.050 | 16.0 |
| 1.00 N | 0.010 | 1.189 | 0.1 | 0.010 | 1.050 | 0.7 |
| b. 11/05/74 | | | | | | |
| Control | 0.010 | 0.186 | 0.3 | 0.011 | 0.126 | 1.3 |
| 0.05 P | 0.060 | 0.186 | 5.1 | 0.060 | 0.126 | 3.8 |
| 0.05 P + 1.0 N | 0.060 | 1.186 | 27.6 | 0.060 | 1.126 | 23.3 |
| 1.00 N | 0.010 | 1.186 | 0.3 | 0.011 | 1.126 | 0.9 |

8. Discussion -

The control yields of the assay alga, Selenastrum capricornutum, indicate that the potentials for primary production in Lakes Vernon and Anacoco were low to moderate at the times of assay sample collection. In assays for both lakes, for both sampling occasions, growth response with the additions of nitrogen indicated phosphorus limitation. Maximum growth yields were achieved with the simultaneous addition of phosphorus and nitrogen.

Mean N/P ratios for Lake Vernon were 26/1, 20/1, and 23/1 for the spring, summer, and fall sampling seasons, indicating phosphorus limitation. Mean N/P ratios for Anacoco Lake were 9/1, 13/1, and 9/1 for the three sampling seasons, suggesting nitrogen or co-limitation.

It should be noted that significant chemical changes took place in Louisiana lake samples between collection and algal assay. The assay data should be considered in this context and until such differences are resolved, used with caution for any prediction of actual lake conditions. Such chemical changes are likely to alter the control yield as well as modifying the N/P ratio.

## IV. NUTRIENT LOADINGS
(See Appendix D for data)

For the determination of nutrient loadings, the Louisiana National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the maps (pages v-vi), except for the high runoff month of February (also March and April for Lake Vernon) when two samples were collected. Sampling was begun in June 1974. Sampling for Lake Vernon was completed in May 1975 and for Nacoco Lake, in March 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Louisiana District Office of the USGS for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a USGS computer program for calculating stream loadings. Nutrient loads indicated for tributaries are those measured minus known point source loads, if any.

Nutrient loadings for unsampled "minor tributaries and immediate drainage" ("ZZ" of USGS) were estimated by using the mean annual nutrient loads, in $kg/km^2/yr$, at Stations 2217C-1, D-1, and 2201A-2, B-1, C-1, and F-1, and multiplying the means by the ZZ area in $km^2$.

A. Waste Sources (both lakes):

1. Known municipal - None

2. Known industrial - None

Estimate for Lake Tahoe based on 65 Tahoe residences.
Estimate for Tahoe-Truckee based on 65 Tahoe residences.
Estimated (see 65 service days Tahoe No. 175).
Source: probably due to either source differences or unequal precipitation (see Section 3.4.2).

| Source | Lake Tahoe | | Source | Tahoe-Truckee | |
|---|---|---|---|---|---|
| | gal/day | gal/day | | gal/day | gal/day |
| a. Undeveloped (undeveloped land) - | | | a. Undeveloped (undeveloped land) - | | |
| a1 Annually (Tahoe Basin) | 1,165 | 1,165 | a1 Annual precipitation - Tahoe | 1,575 | 1,575 |
| a2 Annually (Tahoe Basin) | 2,915 | 2,915 | a2 Annual precipitation - Truckee | 2,915 | 2,915 |
| b. Single family dwellings - | | | b. Single family dwellings - | | |
| b1 Annually (Tahoe Basin) | 4,370 | 364.2 | b1 Annual precipitation - Tahoe | 722 | 722 |
| b2 Annually (Tahoe Basin) | 2,915 | 242.9 | b2 Annual precipitation - Truckee | 2,915 | 242.9 |
| b3 Annually (Tahoe Basin) | 2,915 | 242.9 | b3 Annual precipitation - Tahoe | 722 | 722 |
| b4 Annually (Tahoe Basin) | 2,915 | 242.9 | b4 Annual precipitation - Truckee | 2,915 | 242.9 |
| c. Condominiums (condominium land) - | | | c. Condominiums (condominium land) - | | |
| c1 Annually (Tahoe Basin) | 2,915 | 242.9 | c1 Annual precipitation - Tahoe | 722 | 722 |
| c2 Annually (Tahoe Basin) | 2,915 | 242.9 | c2 Annual precipitation - Truckee | 2,915 | 242.9 |
| d. Motels (motel land) - | | | d. Motels (motel land) - | | |
| d1 Annually (Tahoe Basin) | 2,915 | 242.9 | d1 Annual precipitation - Tahoe | 722 | 722 |
| d2 Annually (Tahoe Basin) | 2,915 | 242.9 | d2 Annual precipitation - Truckee | 2,915 | 242.9 |
| e. Commercial (commercial land) - | | | e. Commercial (commercial land) - | | |
| e1 Annually (Tahoe Basin) | 2,915 | 242.9 | e1 Annual precipitation - Tahoe | 722 | 722 |
| e2 Annually (Tahoe Basin) | 2,915 | 242.9 | e2 Annual precipitation - Truckee | 2,915 | 242.9 |
| f. Industrial (industrial land) - | | | f. Industrial (industrial land) - | | |
| f1 Annually (Tahoe Basin) | 2,915 | 242.9 | f1 Annual precipitation - Tahoe | 722 | 722 |
| f2 Annually (Tahoe Basin) | 2,915 | 242.9 | f2 Annual precipitation - Truckee | 2,915 | 242.9 |
| g. Schools (school land) - | | | g. Schools (school land) - | | |
| g1 Annually (Tahoe Basin) | 2,915 | 242.9 | g1 Annual precipitation - Tahoe | 722 | 722 |
| g2 Annually (Tahoe Basin) | 2,915 | 242.9 | g2 Annual precipitation - Truckee | 2,915 | 242.9 |
| h. Other institutional (OIs) - None | | | h. Other institutional (OIs) - None | | |
| i. Other institutional (OIs) - None | | | i. Other institutional (OIs) - None | | |
| j. Other institutional (OIs) - None | | | j. Other institutional (OIs) - None | | |
| k. Other institutional (OIs) - None | | | k. Other institutional (OIs) - None | | |
| l. Other institutional (OIs) - None | | | l. Other institutional (OIs) - None | | |

a. Annual Total Precipitation Loading - Average Year

1. Source -

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

| Lake Vernon | | | Anacoco Lake | | |
|---|---|---|---|---|---|
| Source | kg N/yr | % of total | Source | kg N/yr | % of total |
| a. Tributaries (nonpoint load) - | | | a. Tributaries (nonpoint load) - | | |
| B-1 Brushy Creek | 5,590 | 5.6 | A-2 Bayou Anacoco | 73,175 | 44.7 |
| C-1 West Anacoco Creek | 17,570 | 17.4 | B-1 Caney Creek | 5,785 | 3.5 |
| D-1 East Anacoco Creek | 24,530 | 24.4 | C-1 Sandy Creek | 14,845 | 9.1 |
| | | | F-1 Prairie Creek | 39,505 | 24.2 |
| b. Minor tributaries and immediate drainage (nonpoint load)- | 33,610 | 33.5 | b. Minor tributaries and immediate drainage (nonpoint load)- | 18,025 | 11.0 |
| c. Known municipal STP's - None | | | c. Known municipal STP' - None | | |
| d. Septic tanks* - | 695 | 0.7 | d. Septic tanks* - | 905 | 0.6 |
| e. Known industrial - None | | | e. Known industrial - None | | |
| f. Direct precipitation** - | 18,450 | 18.4 | f. Direct precipitation** - | 11,355 | 6.9 |
| Totals | 100,375 | 100.0 | Totals | 163,595 | 100.0 |
| 2. Output - A-1 Bayou Anacoco | 73,175 | | A-1 Bayou Anacoco | 250,740 | |
| 3. Net annual N accumulation - | 27,200 | | Net annual N export*** - | 87,145 | |

*Estimate for Lake Vernon based on 45 lakeside residences.
Estimate for Anacoco Lake based on 85 lakeside residences.
**Estimated (see NES Working Paper No. 175).
***Export probably due to unknown sources and/or sampling error.

D. Mean Annual Nonpoint Nutrient Export by Subdrainage Area:

| Tributary | kg P/km$^2$/yr | kg N/km$^2$/yr |
|---|---|---|
| Brushy Creek | 22 | 365 |
| West Anacoco Creek | 19 | 304 |
| East Anacoco Creek | 16 | 256 |
| Bayou Anacoco | 10 | 248 |
| Caney Creek | 10 | 320 |
| Sandy Creek | 11 | 363 |
| Prairie Creek | 16 | 344 |

E. Mean Nutrient Concentrations in Ungaged Streams:

| Tributary | Mean Total P (mg/l) | Mean Total N (mg/l) |
|---|---|---|
| D-1 Jurdon Creek | 0.018 | 0.543 |
| E-1 Wyatt Creek | 0.118 | 0.567 |

It should be noted that phosphorus levels in Wyatt Creek were substantially higher than values found in other tributaries impacting Anacoco Lake (other tributary total phosphorus values ranged from 0.018 mg/l to 0.038 mg/l). As the Wyatt Creek contributions were not incorporated into the estimates, it is likely that the 22 phosphorus loading for Anacoco Lake is greatly underestimated, resulting in the apparent phosphorus export from that lake. Nitrogen levels for both tributaries D-1 and E-1 were slightly lower than those observed in other streams of the Anacoco Lake drainage basin.

F. Yearly Loadings:

In the following table, the existing phosphorus annual loading is compared to the relationship proposed by Vollenweider (1975). Essentially, his "eutrophic" loading is that at which the receiving water would become eutrophic or remain eutrophic; his "oligotrophic" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A "mesotrophic" loading would be considered one between "eutrophic" and "oligotrophic".

Note that Vollenweider's model may not apply to lakes with short hydraulic retention times or in which light penetration is severely restricted by high concentrations of suspended solids in the surface waters.

Total Yearly Phosphorus Loading ($g/m^2/yr$)

| | Lake Vernon | Anacoco Lake |
|---|---|---|
| Estimated loading for | 0.24 | 0.61 |
| Vollenweider's "eutrophic" loading | 0.55 | 0.92 |
| Vollenweider's "oligotrophic" loading | 0.28 | 0.46 |

## V. LITERATURE REVIEWED

Shampine, W. J. 1971. Chemical, Biological, and Physical Data for the Major Lakes and Reservoirs in Louisiana. Louisiana Dept. of Public Works, #5. Baton Rouge, La.

U.S. Environmental Protection Agency. 1975. National Eutrophication Survey Methods 1973-1976. Working Paper No. 175. National Environmental Research Center, Las Vegas, Nevada, and Pacific Northwest Environmental Research Laboratory, Corvallis, Oregon.

Vollenweider, R. A. 1975. Input-Output Models With Special Reference to the Phosphorus Loading Concept in Limnology. Schweiz. Z. Hydrol. 37:53-84.

# VI. APPENDICES

## APPENDIX A
## CONVERSION FACTORS

## CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x $8.107 \times 10^{-4}$ = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

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# APPENDIX B
# TRIBUTARY FLOW DATA

[illegible]

[illegible]

# APPENDIX C

# PHYSICAL AND CHEMICAL DATA

[illegible]

[illegible]

# APPENDIX D

# TRIBUTARY AND WASTEWATER TREATMENT PLANT DATA

[illegible]

[illegible]

[illegible]

| DATE | TIME | DEPTH | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
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# APPENDIX E

## PARAMETRIC RANKINGS OF LAKES SAMPLED BY NES IN 1974

## STATE OF LOUISIANA

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